Risk Management: Assignment 2
Financial Engineering

Corporate Bond Portfolio: Market Implied vs Real World Default Probabilities

Instructions
- **Delivery:** Friday 18:00 p.m. the 21st of March to <u>financial.engineering.polimi@gmail.com</u>, with subject "RM: Assignment 2, Group #";
- Deliver
  a. a **short** pdf document with the results. List the errors you've found.
  b. the code written in Python using your preferred IDE;
- Fill the gaps where appropriate and correct the errors (in case of incoherences between this document and the code, follow this document);
- Comment (in detail) the code and use explicative variable names;
- Use the data and the curve bootstrapped during the Risk Management: Assignment 0.

Case study
On the 31st of January 2023 the macro hedge fund Polimi Capital has the following positions on fixed rate corporate bonds issued by the firm Beta with rating Investment Grade (IG):
- Long €10m (face value) of a bond with one year maturity, 5% coupon with semi annual (s/a) payments and a market dirty price of €100.00;
- Long €10m (face value) of a bond with two years maturity, 6% coupon with s/a payments and a market dirty price of €102.00.

Questions
1. Derive two distinct intensity values for the two bonds under the assumption that it is constant in time with a recovery rate of 30%. Do you expect them to be equal? Comment on the results.
2. Based on the intensities computed at the previous point, derive an estimate of the default probability of Beta at one and two years;
3. Derive the bond Z-spreads;
4. Assume now that the default intensity of Beta is not constant and derive the default probability of Beta at one and two years from a piece-wise constant intensity. Which bootstrap approach do you think would give a better approximation of Beta's creditworthiness?
5. Derive the historical default probability of Beta at one and two years from the rating transition matrix at one year that you find in the code;
6. Consider the scenario 1 in which the market expectation of the medium-term survival probability of Beta changes instantaneously, so that the dirty price of the two-years bond drops to 97 (with the price of the one-year bond unchanged). Execute a new bootstrap of the intensity and derive a new estimate of the default probabilities;
7. Consider scenario 2 in which the market expectation of the overall creditworthiness of Beta changes due to an acquisition by a high-quality company, so that the dirty price of the bonds rise to:
   a. Bond with one year maturity: market dirty price 101.00
   b. Bond with two years maturity: market dirty price 103.00
Execute a new bootstrap of the intensity and derive a new estimate of the default probabilities.

8. Are the default probabilities between the first and the second year (conditional to the fact that the issuer do not default in the first year) derived under scenario 1 consistent with the equivalent historical probabilities derived from the transition matrix? Discuss the results.